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PROPOSAL FOR DUST GENERATION AND ENGINEERING PARAMETER STUDY IN ROCK LOADING

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ABSTRACT

Rock handling is a major airborne dust source in underground hardrock mines. Rock loading is one specific operation in this field which may present a substantial opportunity for improvement in dust control and engineering practise. A study of the interrelation of rock loading engineering parameters with potential dust control measures is proposed.

KEYWORDS: Rock loading, Engineering parameters, Dust control

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BACKGROUND

Handling of rock is a major aspect of hard-rock mining operations. It is the major source of dust exposure to underground miners working in the mine extraction zones(1,2). Main blasting, orepasses and crushing are larger sources of dust in underground mines. However, they contribute little to total miner dust exposure because of the controls exercised. About 65% of the total dust in the occupied extractive mining zones arises from the rock handling operations. The actual dust exposure of the miners from mine to mine depends greatly on the layout, ventilation system and operational schedules. In rock handling, the operation, rock loading, is widely used and is believed to present a substantial opportunity for improvement in dust control and engineering approach.

One would expect that relationships exist between dust dispersion into the air and pertinent device engineering factors(e.g. energy input as in the case of rock cutting). However, no relevant studies were found as a result of a recently completed literature search. While there have been some publications on dust resulting from loading operations(1,3). Those concerning relevant engineering factors, have dealt with the effects of bucket shape, teeth, oscillating action and operator finesse on ease and time of loading as well as on component wear(4-6). One study has dealt with the efficiency and duty cycles of a diesel-powered scoop-tram(7), but no measurements were made in this study of the power actually applied to the rock to establish loading efficiency. No reports on instrumented studies of rock loading have been found. The studies carried out have been empirical in nature and have relied on the operators achieving optimum operational performance of the loading unit for study purposes.

Wetting of the rock pile is a major means of dust control while loading. Studies have shown that it is possible with wetting to reduce dust dispersion by 90% as compared to dry loading. The remainder of the dust can still be substantial, however, and this part is probably very closely related to the energy applied to the rock in loading. The major part of the airborne dust from a fully wetted rock pile probably comes from fresh breakage caused by further splitting or grinding of rocks in the loading process. The energy is provided by the bucket pushing into the rock pile. Thus, it is important to investigate the entry of the bucket into the rock pile in terms of energy requirements, loading speed and dust generation.

Improved understanding of the loading process potentially could lead to the development of improved loaders and dust control methods. An improved understanding would be particularly important when remote or automatic loading is being considered and when operator finesse is not a factor.

RESEARCH OBJECTIVES

The specific objectives of the rock loading study with respect to loading operations and equipment are:

1. Reduction in airborne dust.
2. Reduction in energy consumption.
3. Development of control algorithms for use in remote or automatic loading of rock.
4. Improved design features such as a flat loading platform.

These studies are likely to be of major benefit in the ongoing process of the application of robotics to mining and, in addition, should reduce the environmental problems associated with the high dust generation found in loading operations.

TECHNICAL APPROACH

It is suggested that the mechanics of loading be systematically studied using an instrumented bucket with instrumented teeth holders so that all forces can be determined. The following study components are envisaged:

1. Design and build instrumented loader.
2. Study tooth and bucket entry into confined rockpile.(The pile should be confined to simulate the constraints on rock movements that occur in underground mining. For instance, in a drawpoint, the rock is confined on three sides and sometimes, as well, by the roof.)
3. Study the effect of jiggling the tooth or the bucket on the forces developed and develop an algorithm for feed back in automatic control of the loading procedure.
4. Quantify the effect of departure from a flat floor on the loading process.
5. Determine the influence, if any, of water on the loading process. It is possible that water acts as a lubricant and facilitates the entry of the teeth and bucket into the rockpile. It may also lubricate the movement between the particles.

ANTICIPATED BENEFITS

1. Information and procedures which, when applied, can result in a reduction in fine dust production and dispersion in rock loading rock loading operations.
2. A decrease in the specific energy consumption obtained in rock loading.
3. Development of control algorithms for automatic control of loading machines.
4. Guidelines for the development of loading machines, in particular, the continuous machines being considered for use in high production stopes.

ESTIMATED COSTS

1. Capital Equipment	$ 100 000
2. supplies	50 000
3. Personnel—It is estimated the project will have a two year duration	
a. Project Engineer–part time at $40 000/year	40 000
b. Technician–full time at 30 000/year	60 000
4.Technical Support—Quarterly visits by CANMET/MRL personnel(3 days per visit)	32 000
The total cost of this project is estimated to be	$ 300 000

WORK PLAN

The project, as described, will require approximately 2 years to complete. If successful it is expected that this study will be followed by field trials on a full scale machine. It is estimated that these field trials, which would be carried out on a co-operative basis with a mining company or mining machinery manufacturer, would cost $500 000.

CASH FLOW ESTIMATES

	Year 1	Year 2
Equipment	100 000	
Supplies	25 000	25 000
Personnel	50 000	50 000
Technical support	16 000	16 000

TECHNOLOGY TRANSFER

It is expected that both proprietary and non-proprietary information will be obtained in this study. The proprietary information will mainly relate to engineering technology and should be available under the CANMET policy of licensing. The non-proprietary information will mainly relate to the health and safety aspects and will be subject to the normal technology transfer process of seminars and publications, as appropriate.

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